



# Development of GIS REST Services for Hydrological Models Developed for the Oak Ridge Site



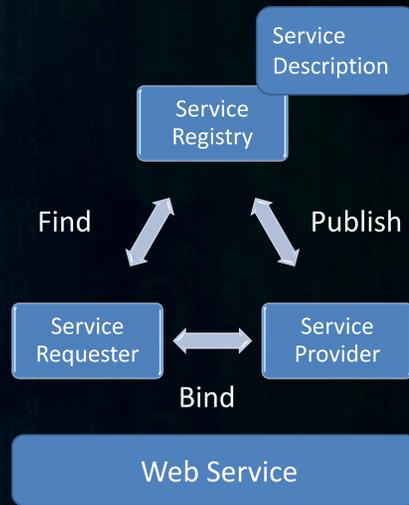
Steve Noel (DOE Fellow)

Applied Research Center, Florida International University

Acknowledgements: Himanshu Upadhyay, Angelique Lawrence, Dr. Leonel Lagos  
DOE-FIU Science and Technology Workforce Development Program

## Introduction

- A Web Service exposes a simple method of communication between computers over the internet. These services can be efficiently consumed by clients such as smartphones, tablets, desktop and web applications utilizing the internet as a medium of exchanging data.
- ArcGIS is a framework used to create and analyze geographical information. ArcGIS for Server allows sharing of geographical data over the web using REST services.
- A REST (Representational State Transfer) Service will be created to publish hydrological models from the Oak Ridge site over the web using ArcGIS Server.



A Web Service is a function at a defined network address that can communicate to any application through the web using Hyper Text Transfer Protocol (HTTP). A Service Provider registers its service to the Service Registry in a universal language like WSDL (Web Services Descriptions Language) which defines a web services' main functionality. Then clients or Service Requesters learn of service functions and requirements through this registry. Once both the Provider and the sender agree and become aware of each other they can exchange data typically in XML (Extensible Markup Language) or JSON (JavaScript Object Notation) format.

## Methodology

- Using Microsoft's WCF (Windows Communication Foundation) framework, a REST Web Service will pull the data from the ArcGIS Server. Authentication will also be implemented using a Web Adaptor.
- The Web Adaptor is a separate piece of software that can be installed on a third-party server which allows a Web Service to connect to ArcGIS Server. Once connected, the Web Service will extract data from the ArcGIS server through its geodatabase.
- The information extracted from the ArcGIS Server will be published through a web application running on a web server.

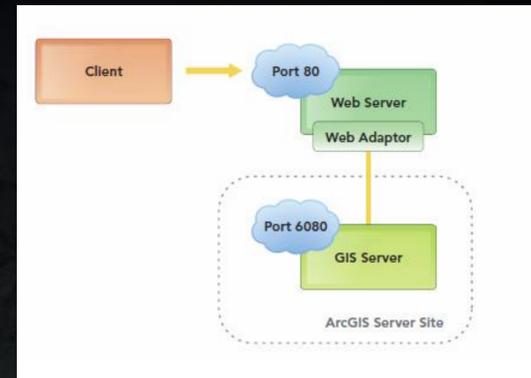


Figure 1. ArcGIS Server Architecture

Different data plotting and rendering techniques will be explored on the Web application to test the performance of the application with large Oak Ridge data models having more than a hundred thousand data points.

A clustering algorithm will be developed for large data sets to minimize the amount of data displayed on the map within a given area. The idea is to group the points on the map into smaller clusters when too many points are within a given area of the map, and ungroup when less points are being displayed.



## Results

- A REST Service was created using Windows Communication Foundation (WCF) which communicates information in JSON (Javascript Object Notation). This service will be connected to a Web Adaptor to begin receiving models from the ArcGIS Server.
- Using ArcMap, various geographic models of the Oak Ridge site have been created from special data gathered on-site. These models will be published on an ArcGIS Server for displaying on the web.

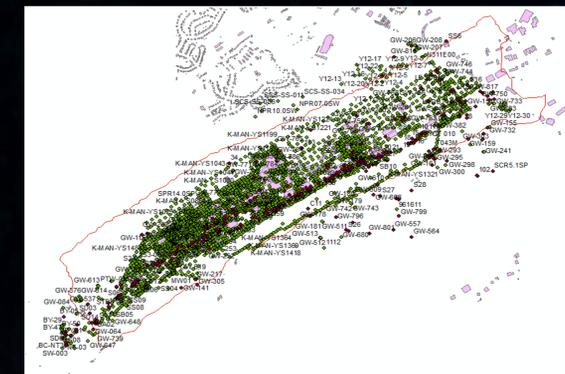


Figure 2. GIS model of Mercury Concentrations in Soil in the Watershed Model Domain

## Mercury Concentration Model

This geographical model shows the Total Maximum Daily Loads (TMDLs) for mercury concentration in surface and ground water in the East Fork Popular Creek at the U.S. Department of Energy's Oak Ridge site. In total there are 54,000 mercury records/data points in this model and over 100,000 flow data records. There were four media types sampled: 1) surface water, 2) ground water, 3) soil, and 4) sediment. The modeling was used to determine the efficacy of stabilization in place with hydrological isolation for remediation of mercury contaminated areas in the Upper East Fork Popular Creek watershed in Oak Ridge, TN. The target mercury concentration for the site was determined based on Tennessee Department of Environment and Conservation (TDEC) regulations for surface waters.

## Path Forward

The REST Service will be connected to the Web Adaptor and tested with actual GIS models from various Department of Energy sites for performance, scalability and management issues.